Emerging platforms in a new information era

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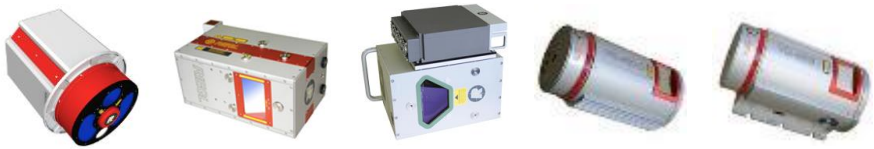
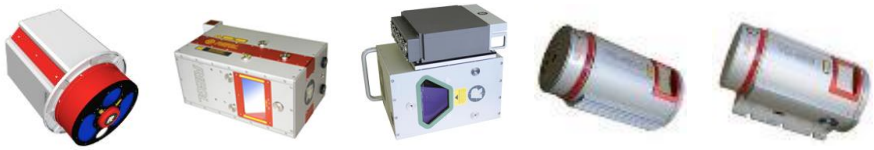
Tampa, FL | May 5, 2015




UNMANNED
ULS



UAV Technological Timeline

1980's – RPV (Remotely Piloted Vehicle)

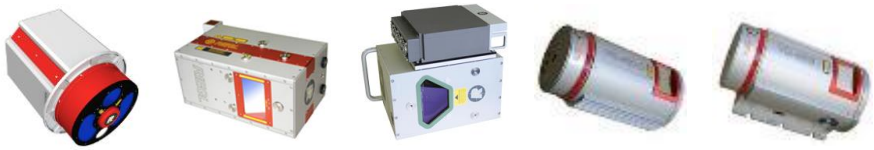
- Operator on ground, almost near real-time control of aircraft.

1990's – UAV (Unmanned Aerial Vehicle)

- Functional flight control systems. Operator on ground takes over intermittently as necessary for course correction.

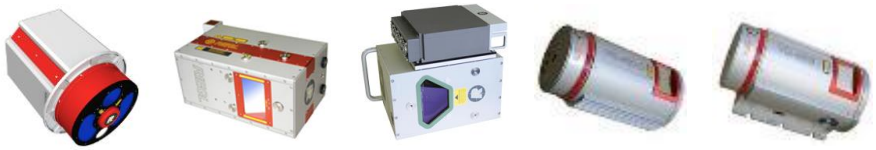
2005+ – UAS (Unmanned Aerial Systems)

- Complete flight path automation. Operator on ground can modify flight path or take over in emergencies.



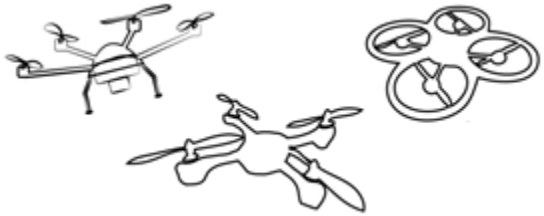
UAV's – Effective New Tool Changing the Landscape of Aerial Surveying and Data Acquisition

- UAS will never replace fully piloted aircraft.
- UAS size = small = decreased radar, acoustical, infrared and environmental signatures.
- UAS is cost effective, as compared to fully manned aircraft (cheaper fuel costs, no crew downtime, minimal aircraft maintenance, no aircrew, minimal weight, easy mobility).
- Safety is improved due to both piloted and autonomous flight.



Advantages of each type of UAV's

Multi-Rotors



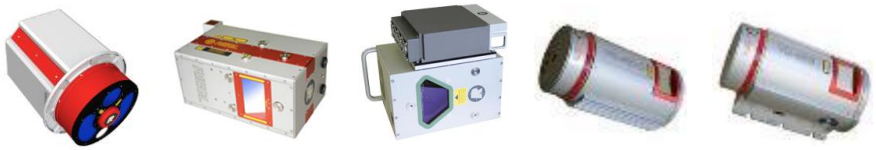
- Complexity of system design has increased and developed over recent years.
- Lighter and stronger materials and components
- Multi-rotor components readily available
- No need for a runway
- Vertical take off
- Hovering in place
- Low altitude flight

Fixed Wing

- Ability to stay airborne is not a function of the drive motor
- Less overall power consumption per flight.
- Stable in flight
- Robust
- Can survey farther distances
- Good payload capability
- Single motor operation

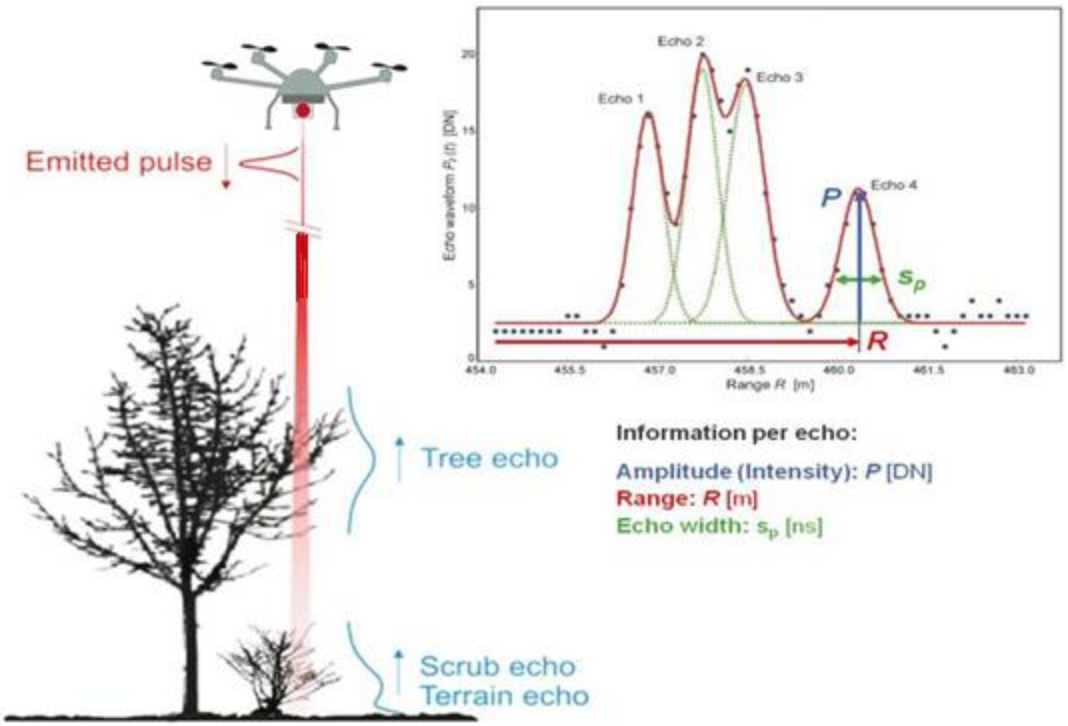
Helicopter UAV

- Highly maneuverable
- Great placement of sensor payload
- Single motor operation
- Vertical take off
- Hovering in place
- Low altitude flight
- No need for a runway

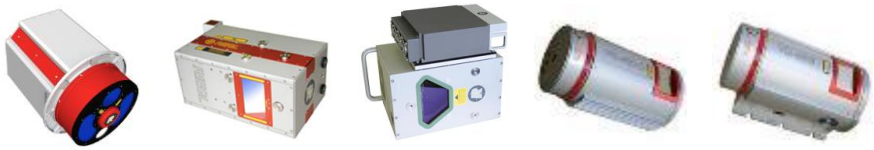


Advantages of Echo Digitization and Waveform Analysis

Interaction of Laser Pulse with Target

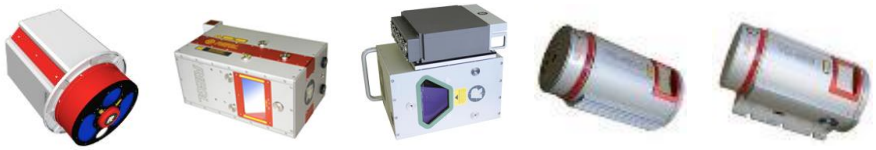


- High multi-target resolution
- High accuracy of multi-target echoes
- Pulse width estimation
- Enables radiometric calibration
- Excellent penetration of vegetation
- Accurate digital elevation map
- Improves classification process
- Remote control and autonomous operation capability

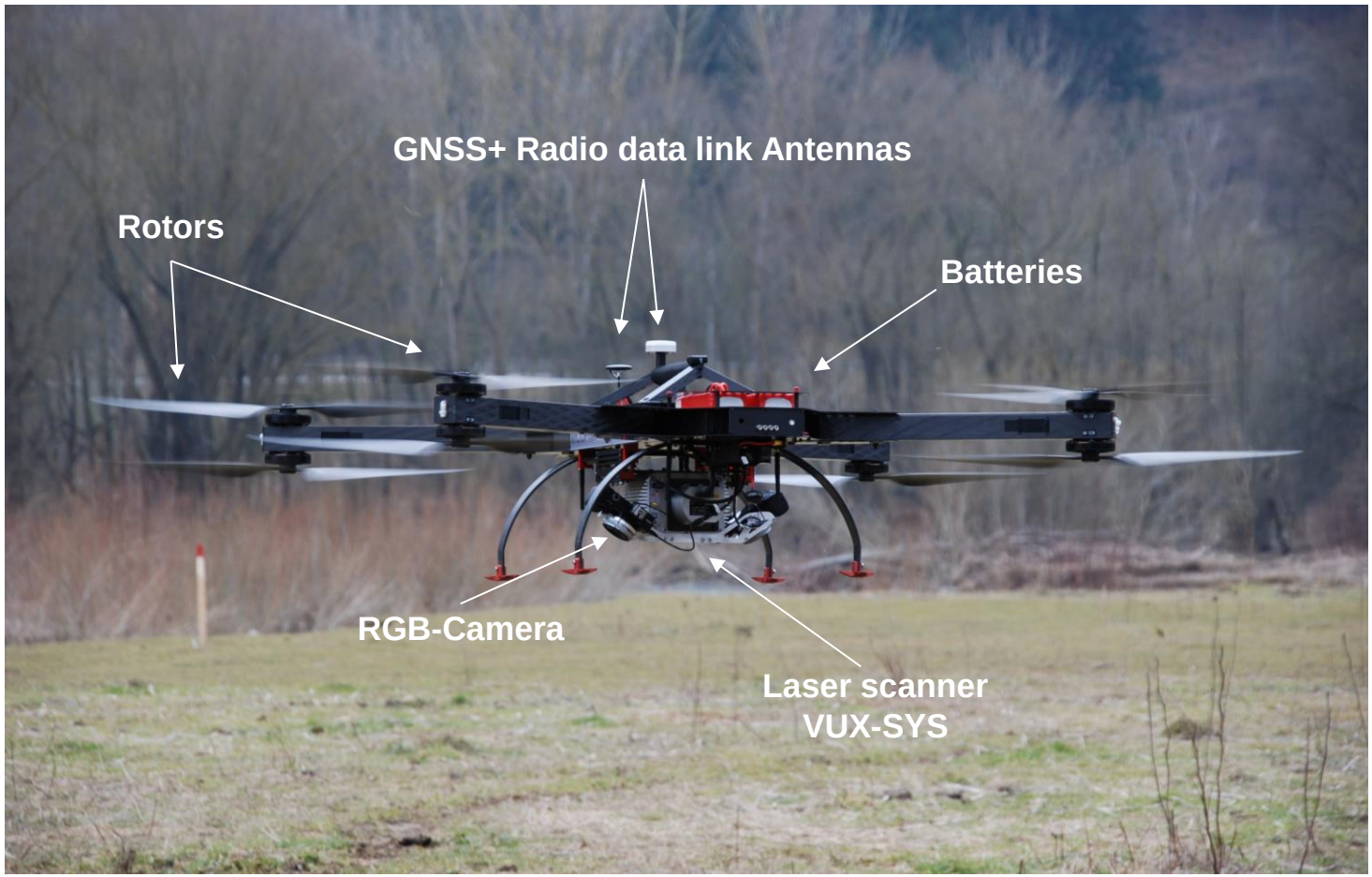


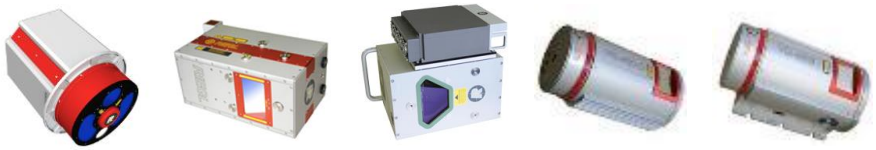
Benefits to LiDAR Integrated UAV's

- New technology allows for LiDAR acquisition at a fraction of the current aerial surveying aircraft costs.
- Small form factor allows for easy mobilization to site and thus, more remote sites.
- Easy mobilization and lower operational costs, as well as time saved, results in a faster return on investment for the LiDAR/UAV remote sensing.
- Faster deployment for repeat scans of an AOI
- Expands LiDAR to new and novel applications currently in use with UAV's.

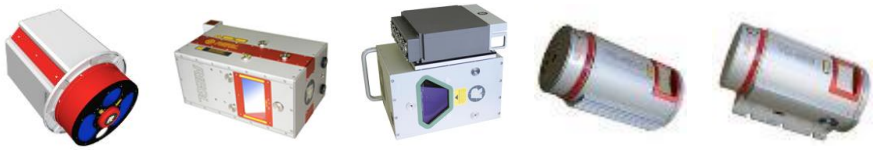


UAS: RiCOPTER w/VUX-SYS Components





UAS: RiCOPTER w/VUX-SYS in action



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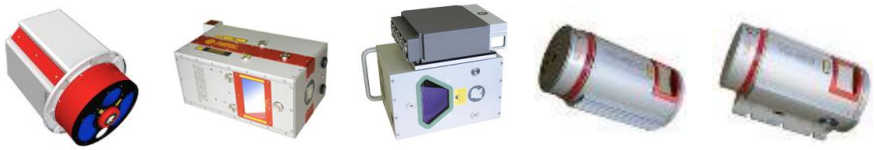
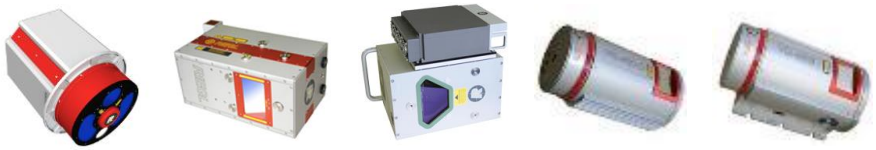


UAS: RiCOPTER w/VUX-SYS Portability

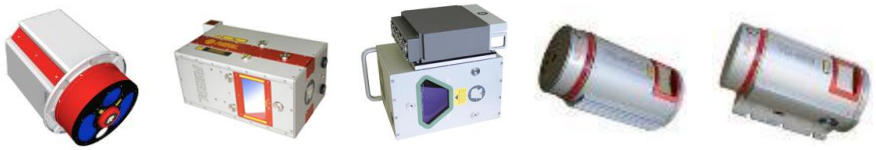


UAS: RiCOPTER Key Facts

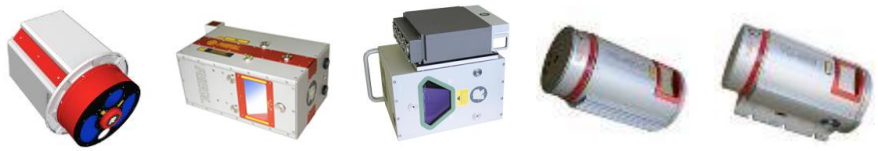
Main Dimensions arms folded (for transportation & storage) arms unfolded (ready to fly)	 624mm x 986mm x 470mm 1,920mm x 1,820mm x 470mm
MTOM (Maximum Take-Off Mass)	< 25 kg
Max. Payload (batteries & sensors)	up to 16 kg
Max. Operating Flight Altitude AGL	> 500 ft operational limits for civil unmanned aircraft according to national regulations to be observed
Flight Endurance (with max. payload)	> 30 min.
Transportation Case (dimensions)	1,220mm x 810mm x 540mm

Source: http://www.riegl.com/uploads/tx_pxpriegldownloads/RiCOPTER_at_a_glance_2014-10-29.pdf

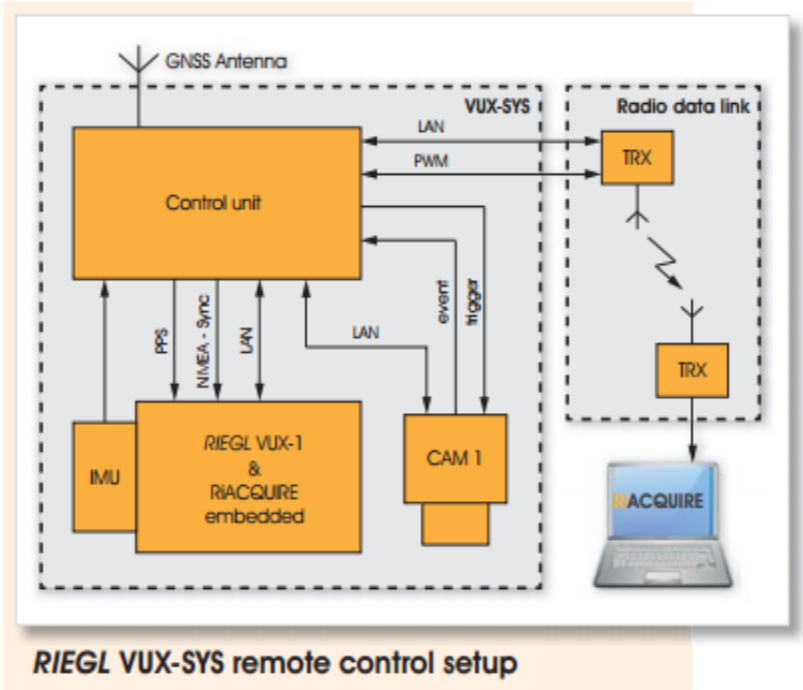
- Robust and reliable airborne scanner carrying platform
- Full mechanical and electrical integration of sensor system components into aircraft fuselage
- Carbon Fiber main frame, foldable propeller carrier arms and shock absorbing undercarriage enable stable flight, safe landings and handy transportation
- Coaxial array of 4x2 propellers enhancing flight stability and failure safety while reducing overall weight



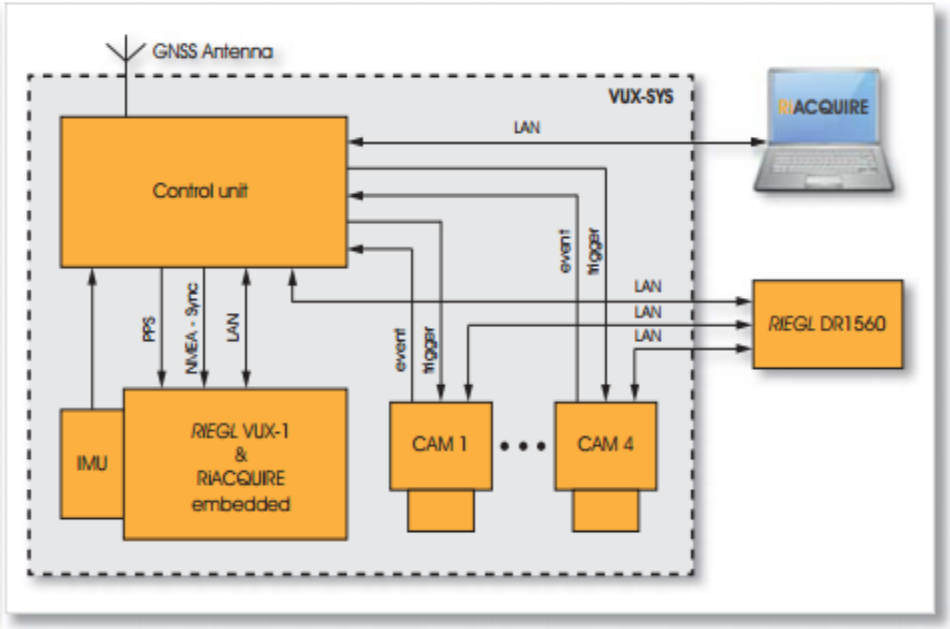
UAS: RiCOPTER w/VUX-SYS Components



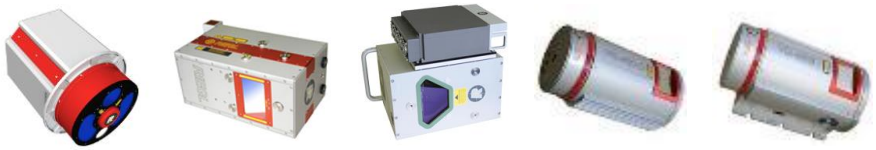
RIEGL VUX-SYS Workflow



***RIEGL* VUX-SYS remote control setup**

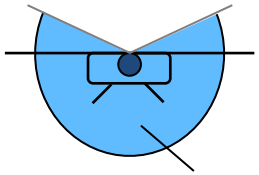


***RIEGL* VUX-SYS conventional control setup**

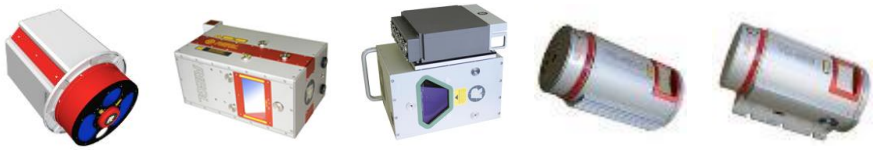


RIEGL VUX-SYS Key Facts

System Components	• *RIEGL* VUX-1 UAS LiDAR sensor • IMU/GNSS unit with antenna • control unit • up to 4 cameras (optional)
***RIEGL* VUX-1 Scanner Performance when integrated in RiCOPTER**	
Field of View (FOV)	230°
max. effective measurement rate	up to 350,000 meas./sec
max. range @ target reflectivity 20 %	550 m
minimum range	3 m
range accuracy	10 mm
eye safety class according to IEC60825-1:2007	Laser Class 1
IMU/GNSS Unit	
accuracy Roll, Pitch / accuracy Heading	0.015° / 0.035°
IMU sampling rate	200 Hz
position accuracy (typ.)	0.05 m - 0.3 m
Camera Interfaces	4x trigger and event marker

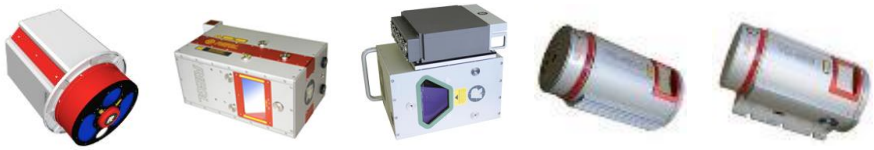


FOV: 230°



RIEGL VUX-1

- High-accuracy ranging
- Survey grade measurement
  - Accuracy/Precision 10mm/5mm
- High laser pulse repetition rate of **550kHz** for fast acquisition
- Fast scan speed up to **200 scans / sec**
- Operating altitude of more than 1000ft
- **Internal data storage** capability of 240 GB
- **Low power consumption** of 60W while scanning



Applications of LiDAR integrated UAV's

Powerlines

Pipelines

Canyons

Forests

Architecture - Cultural Heritage

Caves

Narrow Urban Areas

Gas Lines

Wind Parks

Cliff Overhangs

Substations

Agricultural Land

Aquaducts

Danger areas

Offshore Oil Rigs

Power Plants

Traffic Accident Scenes

Archeological Sites

Port Facilities

Bridges

Open pit mines

Valleys

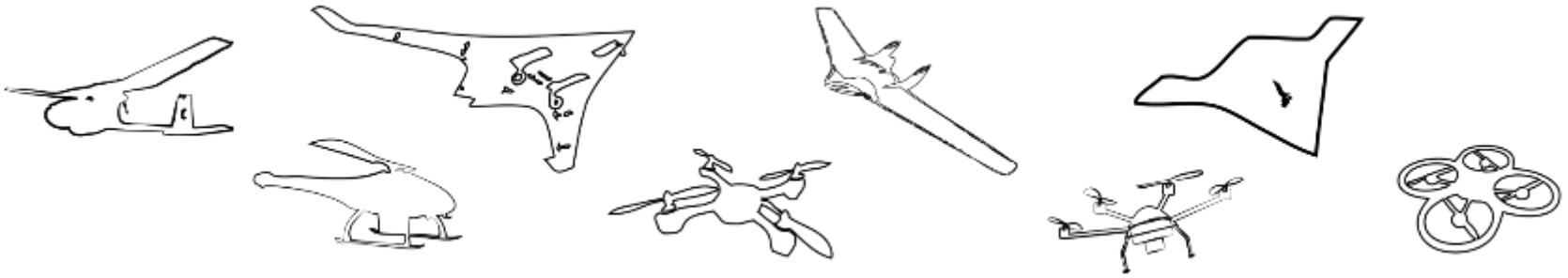
Golf Courses

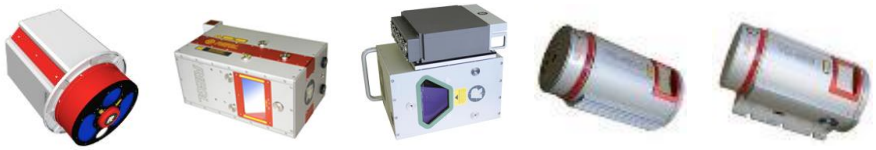
Flood Zones

Complex Industrial Plants

Wildlife Refuges

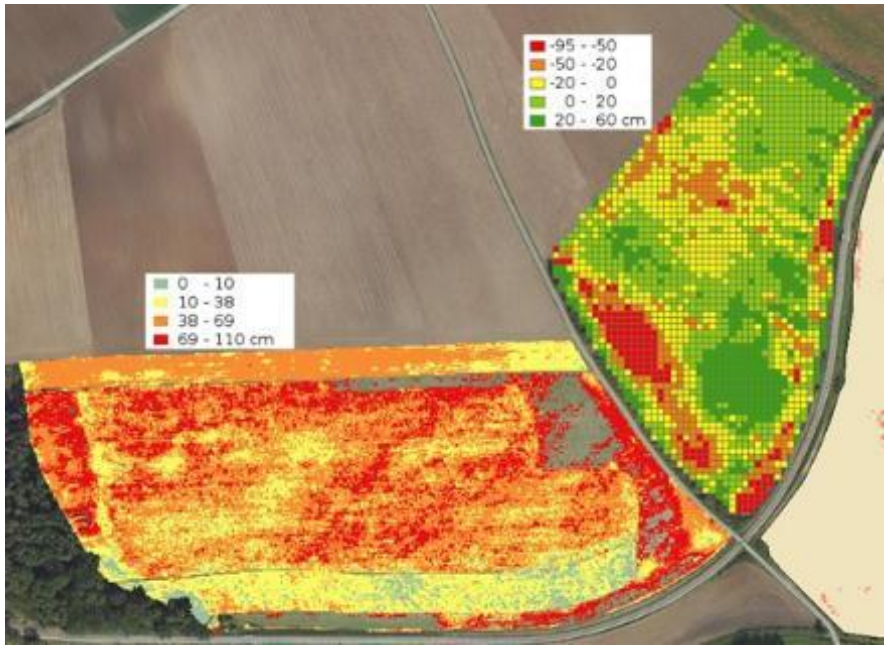
Racetracks





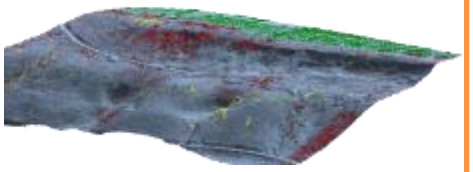
Example of Applications

Application: Precision Agriculture

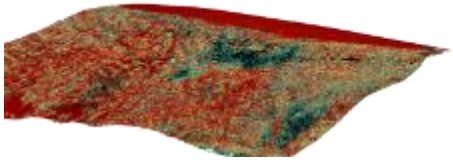


Application: Forestry

Lidar data



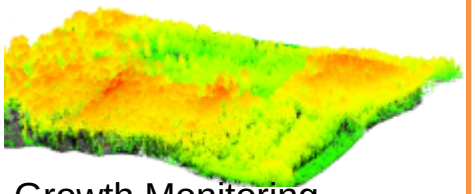
Shrub layer & Deadfall



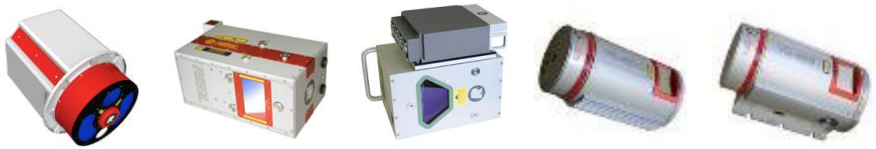
Ground Conditions

Terrain Model

Vegetation

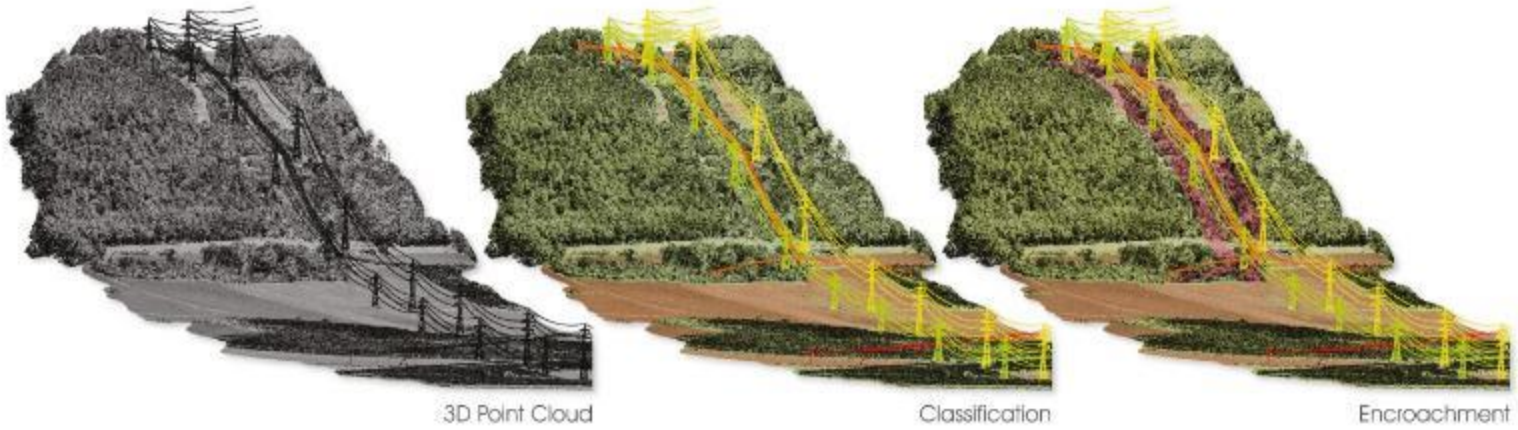


Growth Monitoring

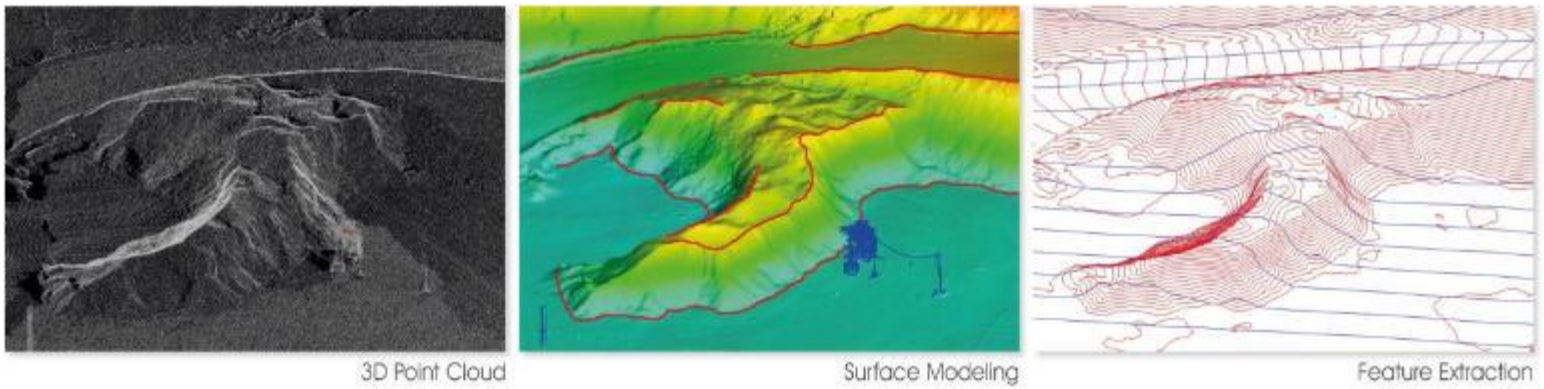


Example of Applications

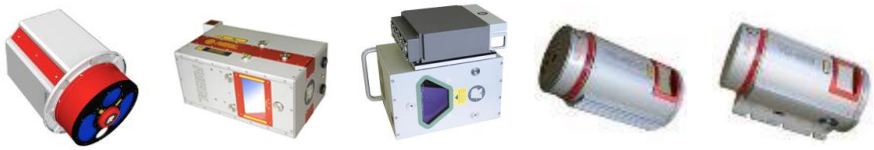
Application: Power Line Inspection & Infrastructure Monitoring



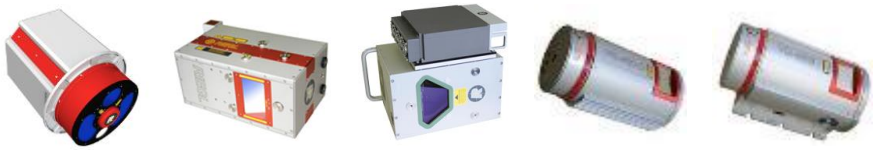
Application: Topography in Open-Pit Mining Areas



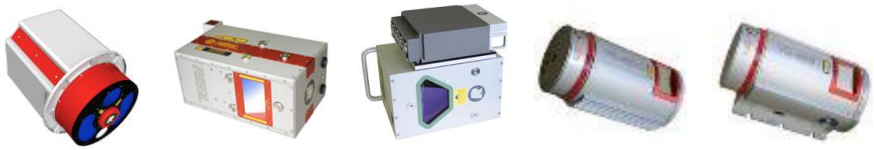
ALS



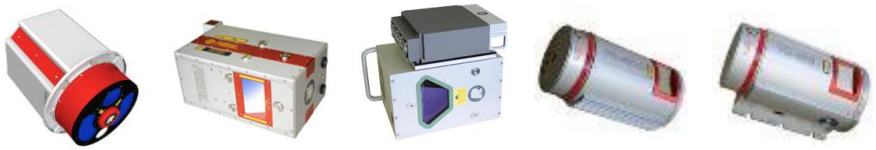
Study Area: Pielach



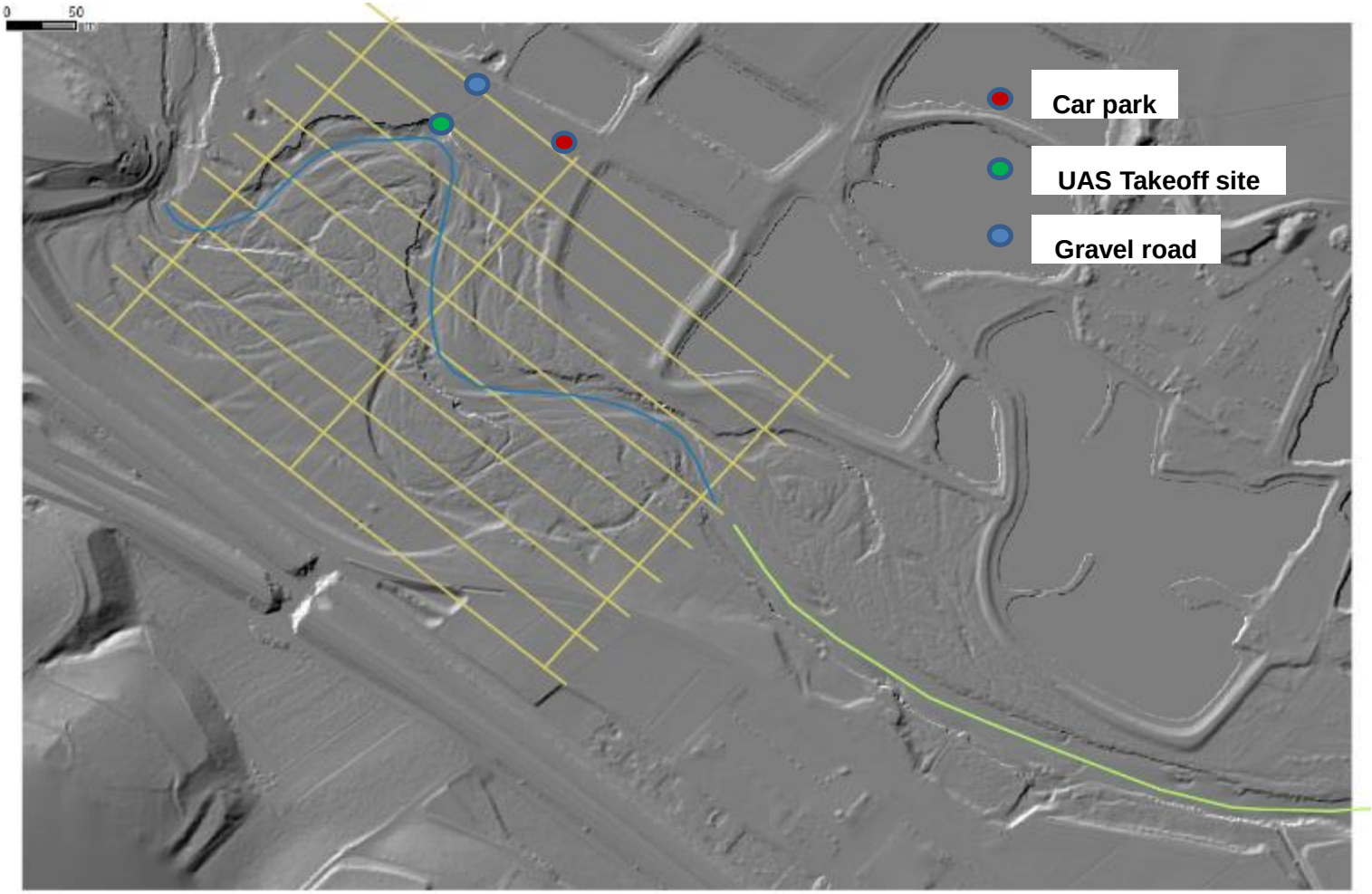
Study Area: Test Plan

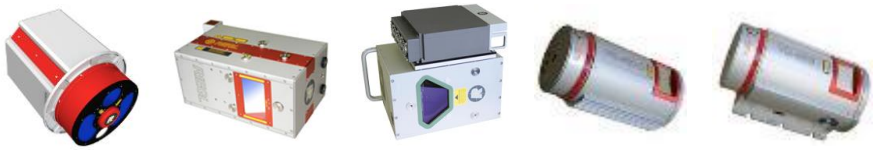


Data Capture: Live Video Stream/Downlink

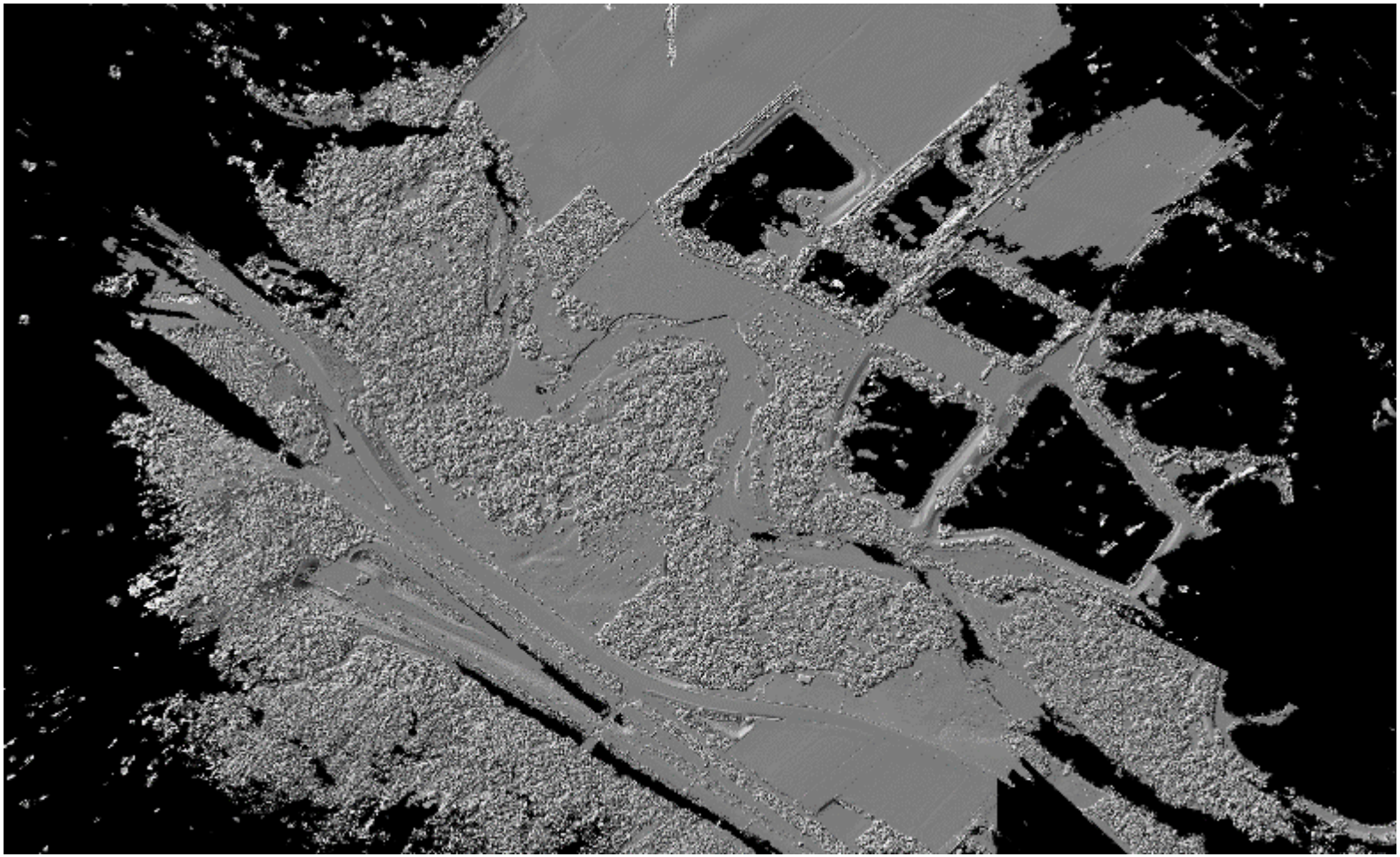


Data Acquisition: Flight Planning

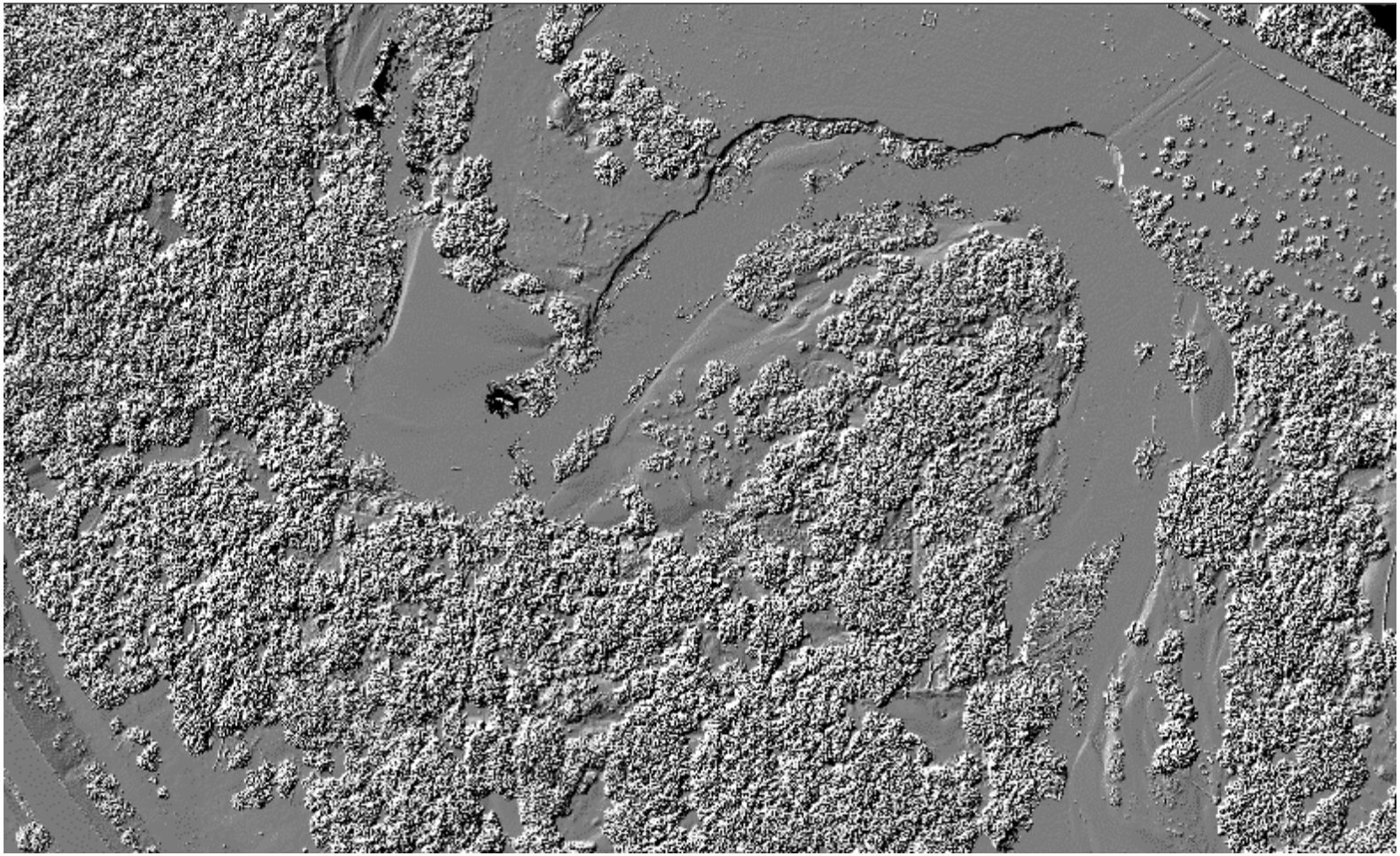


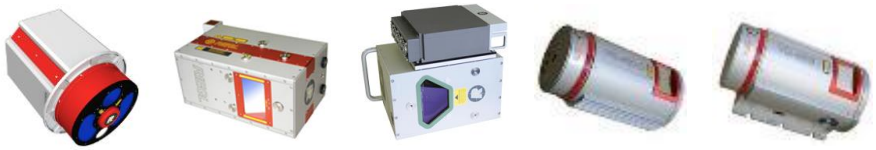


Data Acquisition: Flight Block Overview

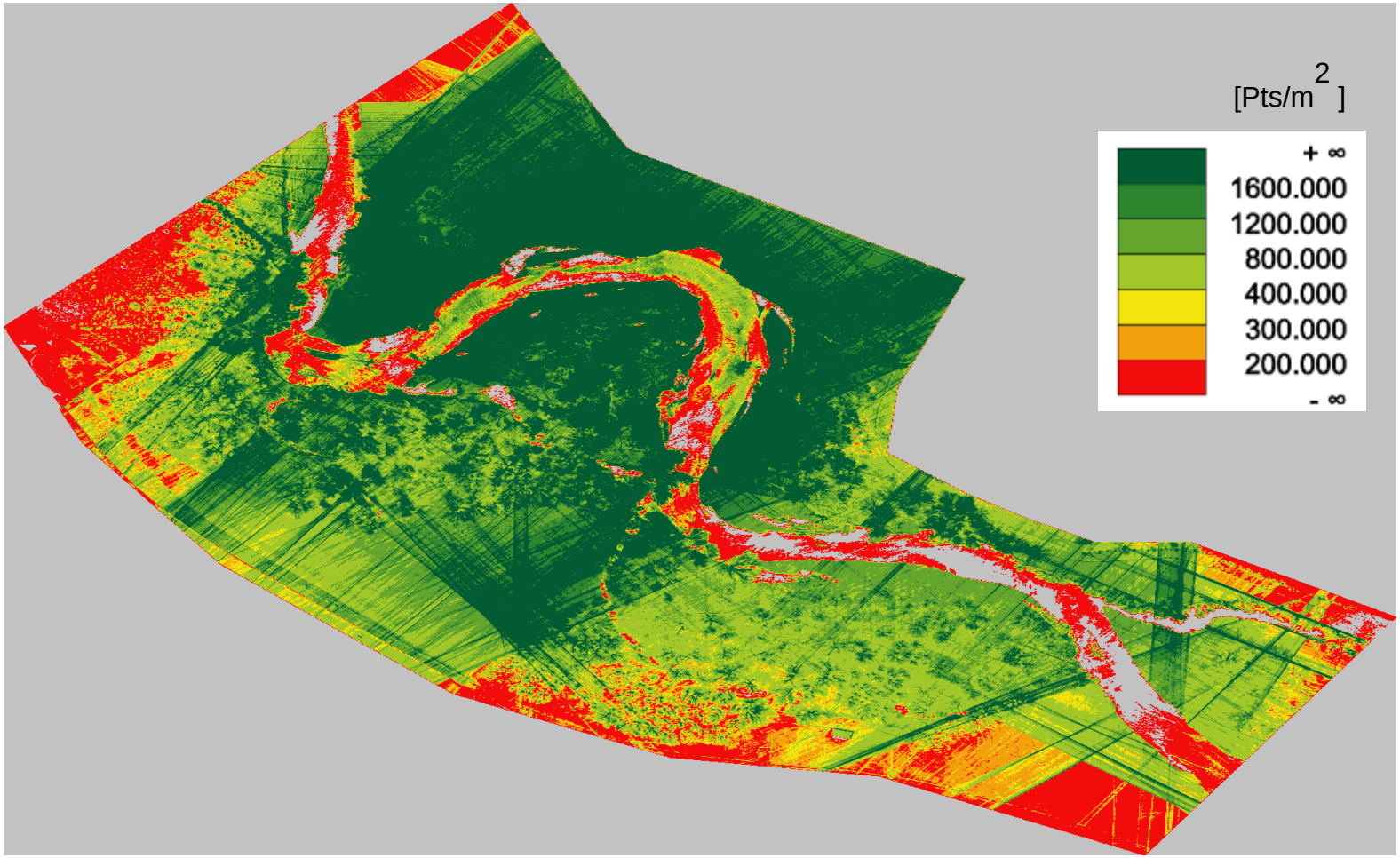


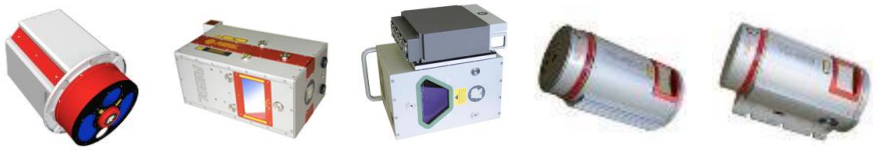
Data Acquisition: DSM Shading Detail



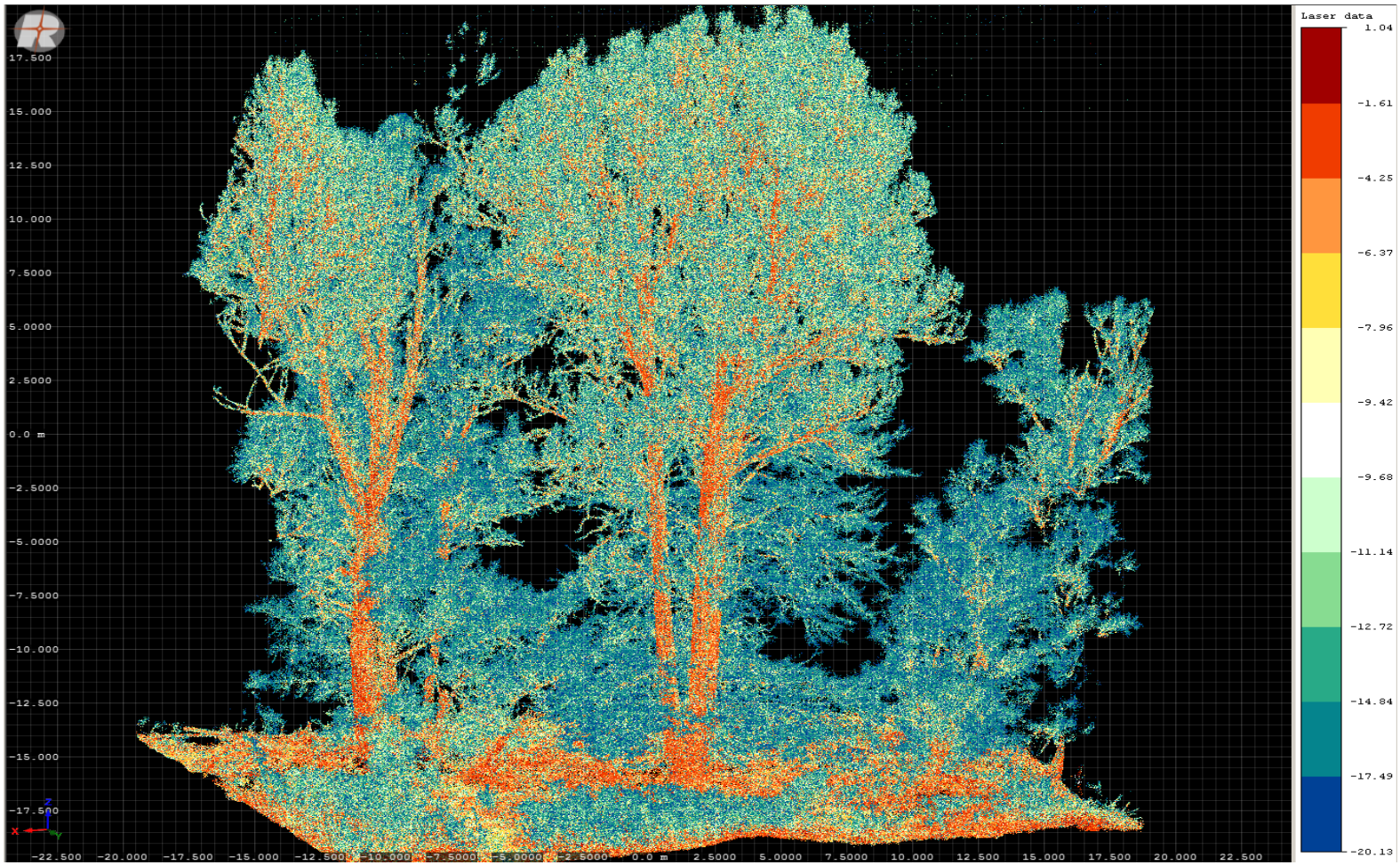


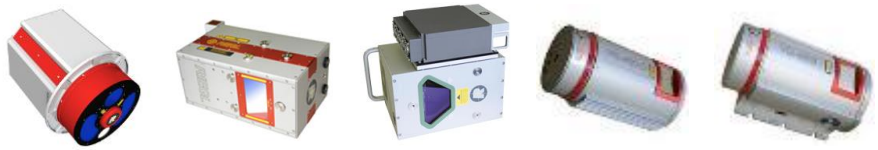
Data Capturing: Point Density



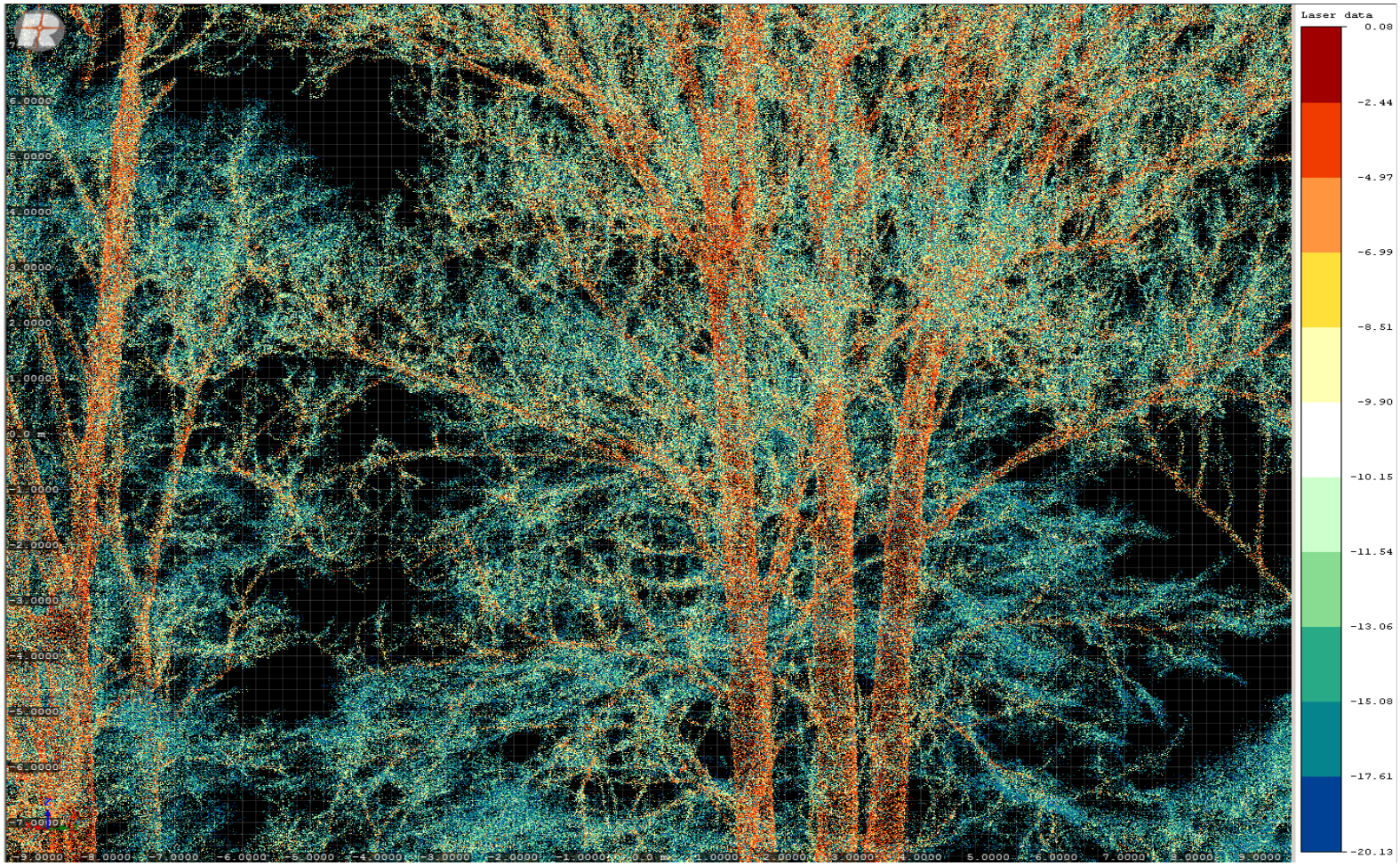


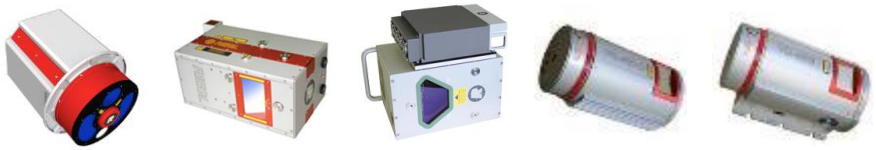
3D Point Cloud: Alluvial Forest



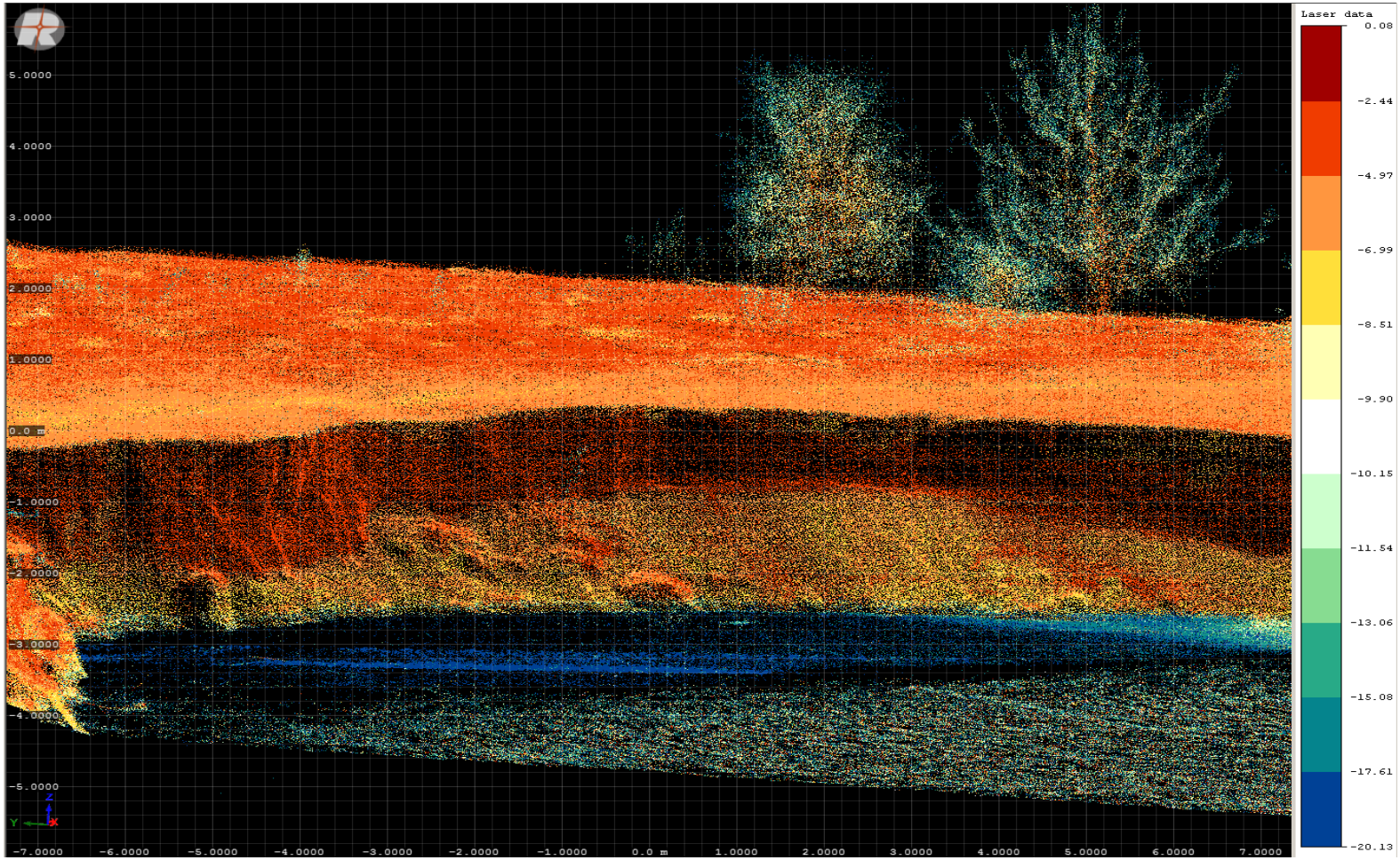


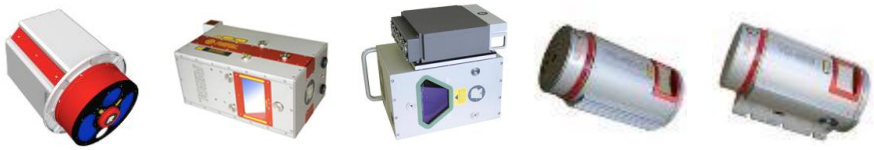
3D Point Cloud: Alluvial Forest Branches





3D Point Cloud: Steep Bank & Floodplain





Conclusion

RIEGL Laser Measurement Systems' latest developments, the RiCopter and the VUX-SYS, are the first systems in the ULS segment that are bridging the gap between airborne, mobile, and terrestrial laser scanning.

ULS systems are bringing professional survey-grade quality of laser scanning that will enable current and new users to be highly productive and to deliver 3D analytics much more efficiently.

Thank You and Any Questions?